

NASA TECH BRIEF



NASA Tech Briefs are issued to summarize specific innovations derived from the U.S. space program, to encourage their commercial application. Copies are available to the public at 15 cents each from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

General Frequency Response Program Calculates Frequency Response of System, Open at Any Specified Element

The problem:

To design a computer program that will provide the frequency response of any linear feedback control system. The analysis of automatic control systems has become an important problem in many diverse disciplines. A central question is that of stability: Do the dependent variables describing a dynamic system remain bounded under the perturbations arising from the physical environment? Because of its ease of application, the frequency response method is a natural tool for stability investigations. Prior programs required reprogramming whenever the equations to be solved were changed.

The solution:

The General Frequency Response Program enables computation of the open loop control system. The system characteristic matrix, obtained from the Laplace transformations of the dynamic and control equations, is input to the program. A variety of outputs are available, including a detailed print, a summary print, and Nyquist and Bode plots. Other program features of interest are the following: variable frequency increment, multiple frequency range, parameter variation, amplitude to decibel conversion, and linear interpolation of amplitudes and phases at critical points.

How it's done:

The system of differential equations under consideration is assumed to be homogeneous (no input signals) and to have zero initial conditions. The equations must be linear, with constant coefficients, and have Laplace transformations representable as products of polynomials and transformed variables.

Two formulations of the stability problem must be considered: all program operations are performed upon matrices, while the best understanding of the transfer function concept is afforded by a signal flow diagram representation. An alternative formulation is provided by the block or signal flow diagram. This representation is a network of blocks and nodes, each block having a designated input and output node, each node being a source of inputs to some block, a sink of outputs from others.

The program enables computation of the response of three types of functions: open loop transfer functions, closed loop transfer functions, and transfer functions expressed as ratios of polynomials.

Notes:

1. This program is written in the Fortran IV language for the IBM 7044-7094 direct coupled systems.
2. Inquiries concerning this program may be made to:
COSMIC
Computer Center
University of Georgia
Athens, Georgia 30601
Reference: B67-10521

Patent status:

No patent action is contemplated by NASA.

Source: James Prosch
of The Boeing Company
under contract to
Marshall Space Flight Center
(MFS-12817)

Category 06